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INTERACTIONS BETWEEN TEMPORAL LOBE SIGNS, IMAGININGS, BELIEFS AND GENDER: THEIR EFFECT UPON LOGICAL INFERENCE

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ABSTRACT

Rotton's Paralogic Test, Wilson-Barber's Inventory of Childhood Memories and Imaginings (ICMI) and the PPI (Personal Philosophy Inventory) were administered to 100 male and 100 female university students. Both sexes displayed moderately strong (0.50) correlations between content-selected and factor analyzed clusters of possible temporal lobe signs, exotic beliefs and the numbers of childhood imaginings. Although there were no sex differences between the accuracy of logical statements that contained paranormal or neutral content, males who displayed more temporal lobe signs were more accurate for logical items that contained paranormal content. Females who displayed more imaginings were more accurate for valid than for invalid items. Accuracy for items with paranormal content increased with exotic beliefs but not with conservative religious beliefs for both sexes. The relationship between exotic beliefs and accuracy for items with paranormal content was especially strong for females. These results suggest: 1) gender differences in the neurocognitive processes that contribute to logical problem solving and 2) accuracy may depend upon the degree to which the subject matter is commensurate with the person's history of enhanced temporal lobe signs, capacity for fantasy and imaginings and beliefs in exotic concepts.

Language processing and cognition have been intimately associated with the temporal lobes of the human brain. Stimulation of the deep structures of the temporal lobes of limbic epileptic patients can generate complex imagery and

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evoke significant alterations in cognitive processes [1-4]. Patients with electrically labile foci within the temporal lobes also display alterations in inferencing strategies that emphasize dependence upon intuitive modes of problem solving [5, 6]. When the alterations in inferencing become extreme or dominate the person's interpretation of the world, delusional themes become more prominent [7, 8]. They can often influence the person's capacity to generate the types of inferences that are required for logical thinking.

We have hypothesized that temporal lobe epileptics exist at the extreme end of a continuum of limbic electrical activity [9-11]. If this prediction is correct then similar but less intense experiences and behaviors, typical of those with known electrical foci within deep temporal lobe structures, should also exist within the *normal population*. People who display more of these signs should display enhanced linguistic creativity, imagery and utilization of intuitive (insightful) processes for problem solving; because these people would be prone to the consequences of the facilitated connection between the sensory-limbic systems [12], people who endorse more temporal lobe symptoms (TLS) should also report more mystical experiences and exotic beliefs. These experiences and beliefs could influence the cognitive strategies by which they solve logical problems that involve sequential inferencing.

These hypotheses have been supported by the manner in which nonclinical populations have answered items from the Personal Philosophy Inventory (PPI). It contains items that refer to experiences, behaviors and beliefs that are less intense than those reported by patients with known, pathological anomalies within the limbic system. The numbers of different possible temporal lobe signs, as determined by the PPI, are positively correlated with the amount of alpha time over the temporal lobes but not the occipital lobes [12], enhanced suggestibility [13, 14], emphasis upon creativity and both childhood and adult imaginings or proneness towards fantasy [13-15]. Numbers of paranormal or psi experiences and beliefs in exotic themes, such as reincarnation and alien intelligence is responsible for UFOs, are also positively associated with the numbers of temporal lobe signs [10, 16].

The more frequent the number of temporal lobe signs a person reports, the more likely he or she is to be impulsive (in an energetic sense), tense, versatile, imaginative, emotionally sensitive, verbal and interested in philosophical or aesthetic themes. These characteristics are commonly associated with creativity, intuitive thinking and insight-dependent problem solving. In fact one of the most common reports of normal people who display these temporal lobe-like symptoms is the emphasis upon "hunches" or "sudden solutions."

If these inferred changes in the electrical lability of temporal lobe function exist, then people who show enhanced sensitivity might have access to neurocognitive processes that do not depend upon serial or logical strategies. These alternative processes could utilize patterns of inferences because of the widening of affect, a manifestation of the sensory-limbic hyperconnectionism, that frequently

accompanies enhanced temporal lobe signs [11]. Conclusions would be based upon the emotional dimensions of the words and concepts within the syntax rather than their literal or frank semantic characteristics.

The greater dependence upon the affective or emotional dimensions of the words within an argument or logical sequence would emphasize the importance of the problem solver's beliefs. Beliefs can be defined as the largest of the affective domains that determine the direction of inference in a manner similar to how the learned syntax of a person's language determines the order of different classes (e.g., nouns, verbs) of words. These affective domains or beliefs are expected to be most influential at the nodes of bifurcation in an inferential sequence, where two distinct outcomes might emerge. Whereas one consequence of the divergence would result in conclusions that were irrelevant to the problem solver, the other consequence could violate the person's private delusion, such as immortality, superior intelligence or the existence of god.

If this process exists then people with a predilection for certain beliefs might be expected to solve problems that contain specific content more effectively than people who do not share these beliefs. The accuracy would be enhanced because the inferential process would not be deflected at divergent nodes, thus allowing access to affective cues that facilitate the intuitive or insightful solution of the problem. Because normal people with elevated temporal lobe signs also report more exotic (liberal) beliefs, they would be expected to solve problems that contain this subject matter more accurately than people who do not share these beliefs.

A sex difference should also be apparent. Young adult females are more likely to report paranormal experiences, especially those associated with time distortions, and to endorse items that suggest ictal-like temporal lobe signs, relative to young males. That these elevated scores are confounded by the general tendency for females to be more forthright is unlikely since covariance for these factors does not significantly alter the sex differences. If temporal lobe factors are involved with linguistic processing, then these sex differences could influence the manner or strategies by which complex linguistic problems are solved.

We designed this experiment to answer the following questions: 1) Do imagery and temporal lobe signs emerge from the same source of variance?; 2) Do males and females differ significantly in their incidence of imaginings and temporal lobe signs?; 3) Do males and females differ in their ability to solve logical problems?; and 4) Is the accuracy of problem solving affected by the subject matter of the problem and the problem solver's temporal lobe signs and capacity for imagery?

METHOD

Subjects

A total of 100 male and 100 female first- and second-year university students served as subjects. They constituted the first author's undergraduate classes over

four consecutive years. The mean and standard deviation for their ages were 24.3 and 7.3 (range 19-52) years, respectively.

Instruments

The PPI contains 140 nominal (true-false) items that are relevant to discerning possible temporal lobe signs within the normal population. Thirty of these items comprise the TLS (temporal lobe signs) scale [11]; they refer to experiences or behaviors that are considered similar but less intense than those reported by patients with verified electrical foci within the temporal lobes. This scale is composed of two clusters: the primary aggregate, called complex partial epileptic signs (CPES) contains sixteen items that refer to ictal-like experiences while the secondary aggregate, called interictal-like behaviors (ILB) contains fourteen items that refer to cognate behavioral descriptions.

Examples of items from the primary cluster are "Sometimes an event will occur that has special significance for me only" and "while sitting quietly, I have had uplifting sensations as if I were driving over a rolling road." Examples of items from the secondary cluster are "People tell me I 'blank out' sometimes when people are talking" and "When I loose an argument I spend a lot of time thinking about what I should have said." All of the items have been published elsewhere [11]. The test-retest reliability for the major cluster for 10 to 100 days is 0.90 and 0.70, respectively [17]. K-R values range between 0.70 and 0.75. A cluster of 9 items (Q15, 27, 29, 53, 68, 87, 88, 110, and 123) that include references to unusual vibrations, diaries, nocturnal akinesis, becoming lost in a crowded place, experiencing a smell from childhood before falling and sensing a presence has also been determined empirically because of its maximum correlation (0.55) with the alpha rhythm duration from the temporal lobes [12, 15].

In addition to these clusters, aggregates of items that serve as controls (n = 16) for response bias ("yes responding"), beliefs (n = 21), a lie scale and a source of general information (e.g., handedness) are also included; the latter two types of items were not used in this study. The belief items are divided into two clusters. Exotic beliefs (n = 10) refer to items such as "Alien intelligence is probably responsible for UFOs" and "Animals should not be killed for the benefit for Mankind." Religious beliefs (n = 11) include items such as "Belief in science and belief in God are not compatible" and "If God told me to kill, I would do it in His name." Sample items from the control cluster are "I like to buy new things" and "I have a good appetite."

Wilson and Barber's Inventory of Childhood Memories and Imaginings (ICMI) is composed of fifty-two nominal (true-false) items [18]. Although traditionally only a full scale score is given, we have found subclusters that correspond to paranormal experiences (n = 5), moderate imaginings (n = 18) and extreme imaginings (n = 15) as useful clinical indicators [19]. Examples of moderate imaginings are "When I was a child I enjoyed fairytales" and " Although I have

grown and I've had more experiences I still feel basically the same as I did when I was a child." Extreme imaginings included "When I was a child or teenager, at times I was afraid my imagining would become so real to me that I would be unable to stop it" and "I have had an orgasm just by imagining only."

Rotton's Paralogic Test is composed of sixteen arguments or syllogisms that contain a major premise, minor precise and conclusion [20]. The person must decide if the argument is valid ($n = 8$) or invalid ($n = 8$). Half of each of the valid and invalid arguments refer to mundane material while the other half of the arguments refer to paranormal-related material. An example of the former is "If a president is a crook, he would be impeached; Congress did not impeach Nixon. Therefore Nixon is not a crook" and "If flying saucers really existed, somebody would have photographed one. Nobody has ever photographed a flying saucer. Therefore, flying saucers do not exist."

Procedure

Each subject was asked to complete the PPI, Wilson-Barber ICMI and the Rotton's Paralogic Test. For two of the classes, this information was collected during the first two weeks of the fall semester; the information for the remaining two classes was collected during the last month of the winter semester. Subjects were asked to complete the Paralogic Test first and to implement maximum effort because successful completion of this task has been argued to be an indicator of "thinking competence."

The responses for all items of each of the three instruments were loaded by subject code on a VAX computer. Age and gender were indicated. Cluster scores for the PPI and the ICMI were determined by dividing the number of yes responses (or their equivalents for double negatives) by the number of items in the cluster and multiplying by 100. Solutions for the Paralogic Test were computed as defined by Rotton: type correct (normal minus paranormal), total valid (all valid minus invalid) the interaction and the total number correct.

To determine: 1) that the theoretically based clusters from the TLS scale of the PPI and the subscales of the ICMI reflected empirical sources of variance and 2) if different factors existed for males and females separately, factor analyses (varimax) were conducted for items with affirmative values of greater than 15 percent and less than 85 percent; fifty-two of the PPI items whose content is most frequently reported for limbic epileptic patients and forty-nine of the ICMI items met this criterion. The single factors that accounted for most of the variance for male and female subjects for the TLS and ICMI Scales were obtained. The explained variance and numbers of items (all positively correlated with their respective factors) for each of these four factors were: TLS-male (12), TLS-female (10), ICMI-male (8) and ICMI-female (8), respectively; the specific items are shown in Table 1. All analyses were completed by appropriate programs of SPSSX software using a VAX 4000 computer.

Table 1. Specific Items (Indicated by number) that Loaded ($r > 0.40$) upon the Major Factors from the Inventory for Childhood Memories and Imaginings (ICMI) and Temporal Lobe Signs (TLS) Items from the Personal Philosophy Inventory (PPI) for Males and Females Separately

	ICMI First Factor Items: Males
7.	Although I have grown and I've had more experiences, I still feel basically the same as I did when I was a child.
14.	At the present time I am very imaginative.
27.	When I was a young (pre-teenage) child, I had sexual fantasies.
42.	I would like to experience hypnosis.
47.	When I remember significant events in my life, in addition to thinking about them, I can also re-experience them . . .
48.	I can vividly re-experience in my imagination such things as: the feeling of a gentle breeze . . .
49.	When asked to close my eyes and imagine holding a baby or an animal on my lap I can experience it as if it were actually there . . .
52.	If I wish, I am usually able to finish or change a dream after I awaken.
	ICMI First Factor Items: Females
12.	As an adult I still enjoy fairy tales.
17.	When I was playing make-believe games as a child, I usually would imagine so vividly that what I pretended seems real to me.
19.	As an adult, I still occasionally live in a make-believe world.
20.	When I was a young child, I believed that my doll(s) or stuffed animal(s) were alive.
22.	When I was a child, I would at times pretend and in some sense believe I was someone else such as a fairytale character . . .
23.	As an adult I occasionally pretend I am someone else.
31.	If I could not imagine anymore, besides other effects it would have on my life I wouldn't be me anymore . . .
51.	Many or most of my dreams tend to be at least as vivid as actual life experiences.
	Shared TLS Items (female or male only items are indicated by M or F)
20.	Sometimes I am sure that people can tell what I am thinking.
23.	There have been times when I have stared at an object and it appeared to become larger and larger.
29.	While sitting quietly, I have had uplifting sensations as if I were driving quickly over a rolling road.
38.	At least once in my life very late at night, I have felt the presence of another Being.
60.	Sometimes I am so full of pep and energy that I feel superhuman.
62.	When relaxed or just before falling asleep, I sometimes feel pleasant vibrations moving through my whole body.
88.	I often feel as if things are not real.
109.	I have had experiences when I felt as if I were somewhere else.
118M.	I have noticed tingling sensations along the back of my legs.
59M.	People tell me that I become excited about insignificant events.
137M.	Two or three times in my Life, there have been a few brief moments when I felt very close to a Universal Consciousness.
110M.	I have dreams of floating or flying through the air at least once a year.
15F.	I have had a vision.
87F.	When I loose an argument I spend a lot of time thinking about what I should have said.

RESULTS

The means and standard deviations for the major clusters of items from the Personal Philosophy Inventory (PPI), Wilson-Barber Inventory of Childhood Memories and Imaginings (ICMI) Scale and Rotton's Paralogic Scale are shown in Table 2. As indicated by the *F*-values, females endorsed significantly (all $p < 0.01$) more items on the TLS and ICMI scales than did males. Because female subjects also endorsed more items from the control cluster, further analyses were completed that removed the variance associated with the control cluster before gender comparisons were determined. The *F*-values (in parentheses, all *dfs* = 1,197) did not change appreciably. For example values for the major variables were: Total TLS Scale (12.47), Total ICMI Scale (13.07), Primary TLS scale (8.37) and Extreme ICMI cluster (5.06).

There were no statistically significant ($p > 0.01$) differences between sexes for numbers of religious or exotic beliefs. The strongest (first) factors from the TLS and the ICMI did not differentiate males and females vectorially. Females endorsed significantly more of the items within both the male and female factor from the TLS and for the female factor only from the ICMI. In addition, there were no significant differences between sexes with respect to solutions for any of the different types or contents of Rotton's syllogisms.

Table 3 displays the correlation coefficients between the control (for yes responding), TLS (possible temporal lobe symptoms), EEG validated items, ICMI, subjective psi experiences (5 ICMI items), exotic belief and religious belief clusters for females (top right diagonal) and males (bottom). Neither the control nor the religious belief scores were significantly correlated with any of the other scales. Numbers of possible temporal lobe symptoms were significantly correlated with the numbers of childhood imaginings and the propensity to endorse exotic beliefs. The only discrepancy between the two sexes was the significant correlation between paranormal experiences and the numbers of EEG-validated items ($r = 0.60$) for males that was not evident for females ($r = 0.24$).

Table 4 contains the correlation coefficients between the moderate (M) and extreme (E) clusters from the ICMI and the primary (CPES) and less specific clusters of the TLS. As predicted, only the extreme ICMI experiences were more strongly and consistently correlated with the numbers of possible temporal lobe symptoms. In addition (as predicted) exotic beliefs were strongly and significantly correlated, for both sexes, with the extreme cluster of imaginings and both the primary and secondary clusters of temporal lobe signs. Scores for the moderate imaginings cluster were not significantly associated with numbers of exotic beliefs for either gender.

Because of the similarity among items for the female and male clusters for the TLS and ICMI items, the within scale correlations were strong ($p > 0.75$). The major discrepancy between the sexes occurred for the correlation between exotic beliefs and the TLS clusters. The numbers of exotic beliefs for females were

Table 2. Means and Standard Deviations for Major Variables from the Possible Temporal Lobe Signs (TLS), Wilson-Barber Inventory of Childhood Memories and Imaginings (ICMI) and Rotton's Paralogic Scales for Males and Females

	Males		Females		
Variable	Mean	SD	Mean	SD	F-value
PPI Variables (percent affirmative responses)					
Control cluster	74	12	79	10	11.93**
Total TLS scale	29	12	36	11	14.09**
Major EEG items	22	19	33	20	10.64*
Primary TLS cluster	25	15	33	13	11.03**
Secondary TLS cluster	33	12	40	12	12.03**
Male first factor	24	22	34	18	7.83*
Female first factor	26	22	35	21	7.03*
Religious beliefs	43	19	40	18	1.04
Exotic beliefs	43	17	47	17	2.96
Wilson-Barber Scales (percent affirmative responses)					
Total scale	30	10	38	13	16.98**
Psi experiences	12	21	18	20	2.47
Moderate cluster	24	12	34	17	16.25**
Extreme cluster	25	15	32	18	7.40*
Male first factor	36	30	40	21	1.22
Female first factor	36	30	47	30	4.19
Rotton Paralogic Scale (number of items correct)					
Neutral-Paranormal items (Type)	1.0	1.7	0.7	1.6	0.88
Valid vs invalid items (Validity)	–1.0	3.2	–0.4	3.7	0.81
Interaction	–0.5	1.8	–0.4	1.8	0.03
Total items correct	7.9	2.3	7.4	2.1	1.41
Paranormal invalid[a]	–0.7	1.3	–0.6	1.3	0.12

[a]invalid paranormal items—invalid neutral items
*$p < 0.01$
**$p < 0.001$

Table 3. Pearson Correlation Coefficients between the Major Temporal Lobe Signs (TLS), Imaginings (ICMI) and Belief Scales for Females (top right diagonal) and Males (bottom left diagonal)

	Control	TLS	EEGTLS	ICMI	Psi Experiences	Exotic	Religious
Control	—	0.08	−0.08	0.09	−0.24	−0.19	−0.23
TLS	−0.10	—	0.69*	0.40*	0.36*	0.42*	0.10
EEGTLS	−0.10	0.75*	—	0.36*	0.24	0.24	0.14
ICMI	0.08	0.54*	0.60*	—	0.44*	0.44*	−0.08
Psi Experiences	−0.12	0.75*	0.60*	0.52*	—	0.51*	0.14
Exotic	−0.22	0.33*	0.28	0.45*	0.52*	—	0.10
Religious	0.06	0.01	0.04	−0.04	0.04	0.05	—

*$p < 0.01$

Table 4. Pearson Correlation Coefficients between Two Major Clusters of the Imaginings (Wilson-Barber, ICMI), Temporal Lobe Signs and Belief Scales for Males (lower diagonal) and Females (upper diagonal)

	WB-M	WB-E	TLS-P	TLS-S	Exotic	Religious
WB-M	—	0.60*	0.22	0.20	0.22	−0.10
WB-E	0.44*	—	0.43*	0.32	0.44*	−0.05
TLS-P	0.33*	0.49*	—	0.60*	0.39*	0.09
TLS-S	0.12	0.30	0.61*	—	0.37*	0.07
Exotic	0.07	0.35*	0.23	0.40*	—	0.10
Religious	0.01	−0.07	−0.11	0.32	0.04	—

*$p < 0.01$

positively correlated with the TLS factors (both male and female) while the scores for the exotic belief cluster for male subjects were not correlated with these factors. The numbers of exotic beliefs for both sexes were more systematically related to their scores on the male and female ICMI clusters that were derived from factor analysis (Table 5).

In Table 6 the correlation coefficients between the scores on the various clusters and the accuracy of answers for various components of Rotton's logical statements are presented for males and females, separately. Both males and females displayed weak negative correlations between the numbers of exotic beliefs and the relative accuracy for the type of content within the logical argument. Because of the calculation score for "type of content," i.e., a positive score indicating more neutral rather than paranormal items correct, the negative correlations indicated

Table 5. Pearson Correlation Coefficients between Primary Male and Female Factors from the ICMI (Wilson-Barber, WB), and Temporal Lobe Signs Scales and for the Belief Clusters for Males (lower left diagonal) and Females (upper right diagonal)

	WB-M	WB-F	TLS-M	TLS-F	Exotic	Religious
WB-M	—	0.77*	0.22	0.12	0.31*	−0.33*
WB-F	0.79*	—	0.18	0.20	0.28*	−0.18
TLS-M	0.20	0.22	—	0.88*	0.41*	0.00
TLS-F	0.22	0.18	0.95*	—	0.38*	0.09
Exotic	0.33*	0.36*	0.17	0.13	—	0.10
Religious	−0.05	−0.07	−0.02	−0.13	0.04	—

*$p < 0.01$

Table 6. Pearson Correlation Coefficients between Various Measures on the Rotton Paralogic and Major TLS (possible temporal lobe signs), ICMI (imaginings) and Belief Scales for Males and Females

	Type		Valid		Inter		Total	
Variable	M	F	M	F	M	F	M	F
Control	0.17	−0.03	0.14	0.11	0.17	−0.15	0.03	0.20
TLS-P	−0.30*	0.10	−0.32*	0.06	−0.09	0.12	−0.09	−0.05
TLS-S	−0.32*	−0.01	−0.13	0.17	0.16	0.25*	−0.03	−0.11
WB-N	0.03	0.13	0.00	0.37*	0.26*	0.13	−0.20	0.10
WB-E	−0.21	−0.02	−0.19	0.22	−0.14	0.10	−0.16	0.04
Psi Exper	−0.19	−0.33*	−0.10	0.30*	0.09	0.28*	−0.10	−0.14
WB Fac-M	0.04	−0.05	−0.04	0.38*	−0.03	0.24	−0.20	0.20
WB Fac-F	−0.06	−0.10	−0.03	0.30*	0.00	0.30*	0.00	0.19
PPI Fac-M	−0.25*	0.04	−0.35*	0.11	−0.09	0.20	−0.12	−0.12
PPI Fac-F	−0.27*	0.10	−0.41*	0.06	−0.22	0.21	−0.11	−0.06
Exotic	−0.25*	−0.26*	−0.03	0.20	0.13	0.54*	0.11	−0.17
Religious	0.07	−0.24	0.03	0.09	0.24	−0.04	0.00	−0.35*

*$p < 0.01$

that accuracy for paranormal items increased as belief in exotic concepts increased. On the other hand only the male subjects displayed weak but statistically significant and consistent correlations between the type of content within the logical statement and one of the neurocognitive (TLS or imaginings) dimensions. The negative correlation meant that those males with the largest numbers of temporal lobe signs were more accurate for items that contained references to paranormal content within the logical argument (whether or not the item was valid or invalid) than items that contained mundane content.

However the strongest (explanation of more than 10% of the variance) effects occurred for the subjects' responses to syllogistic items as a function of their validity. Quite clearly, the female subjects' accuracy for the validity dimension of the arguments was positively correlated with the *imagining* scores on the moderate and factored clusters from the ICMI scale. Stated alternatively, females who reported more childhood imaginings and memories also more accurately discerned valid statements (regardless of item content). The contribution from temporal lobe signs was not significant statistically.

On the other hand, males' accuracy of statements as a function of their validity was not significantly correlated with imaginings. Instead, these measures were negatively correlated with temporal lobe signs. Males who displayed more temporal lobe signs were more accurate for invalid than for valid statements whereas males with fewer temporal lobe signs were more accurate for valid statements than for invalid ones.

The single most important correlation was between exotic beliefs and the interaction term for the Rotton scale; the coefficient was unusually strong (0.54) and highly statistically significant ($p < 0.001$) for females only. Because of the manner in which the interaction term was calculated, this correlation meant that females who reported more exotic beliefs were also more accurate for valid items that contained paranormal content only. A scattergram of this correlation demonstrated clear linearity of distribution that was not affected by outliers.

Because of the unexpected magnitude of the correlation coefficient and its plotted uniformity, we determined which items were dominating the exotic belief cluster and consequently dominating the correlation. Step-wise multiple regression was completed for females where the score for the (Rotton) interaction term was the dependent variable and the individual items from the Exotic Belief cluster were the independent variables. The items according to order of entry (cumulative multiple r in parentheses) were "Alien intelligence is probably responsible for UFOs" (MR = 0.60), "Although I am not sure, there is a good possibility that I have lived in a previous life" (MR = 0.75) "Telepathy is a real phenomena" (MR = 0.82) and "There is good evidence that life exists on other planets" (MR = 0.87).

Table 7 shows the general factor relationships between the major clusters of items (significant loading defined by $r > 0.40$) from the PPI and the ICMI as well as the relationships between the subclusters from these scales. Quite clearly,

Table 7. Rotated (Varimax) Factors for Each of the Three Steps of Analyses Indicated in Tables 2, 3 and 4 for the Male and Female Groups

	Scores from Major Scales (Table 2)			
	Males		Females	
	Factor 1	Factor 2	Factor 1	Factor 2
Explained	41%	19%	39%	22%
Control	0.02	0.90	–0.01	–0.81
TLS-Total	0.86	0.11	0.72	–0.11
ICMI-Total	0.80	0.20	0.78	–0.21
Psi Experiences	0.86	–0.19	0.74	0.33
Exotic Beliefs	0.52	–0.55	0.77	0.23
Religious Beliefs	0.01	–0.90	0.03	0.70
	Scores from Content-Selected Scales			
Explained	40%	21%	41%	19%
ICMI-M	0.67	–0.04	0.28	0.88
ICM I-E	0.80	0.15	0.54	0.67
TLS-P (CPES)	0.73	0.40	0.81	0.08
TLS-S (ILB)	0.34	0.83	0.78	0.02
Exotic Beliefs	0.32	0.52	0.68	0.14
Religious Beliefs	–0.38	0.70	0.38	–0.62

Note: *r*-values greater than the absolute value of 0.40 considered statistically significant.

possible temporal lobe signs, imaginings and exotic beliefs loaded on the same factor for males and for females when total cluster scores are involved. When the subcluster scores are employed, differential loadings between the sexes occurred. The strongest factor for males involved both ICMI scales and the primary TLS cluster while the strongest factor for females was loaded by the extreme ICMI cluster only, the two TLS subclusters and exotic beliefs. Whereas factor 2 for females was dominated by only the two ICMI subclusters, factor 2 for males was dominated by the belief clusters and the secondary TLS cluster.

DISCUSSION

The relationships between temporal lobe function, language and imagery are indisputable [21]. The results of this study support the psychometric association between temporal lobe signs as defined by the PPI and imaginings as defined by the Wilson-Barber Inventory. Both males and females displayed moderate

strength correlations between these two scales (Table 3). Items from the PPI that had been specifically correlated with the amount of temporal lobe alpha activity in another study [12] were also correlated with childhood imaginings.

As reported previously [10, 17] imaginings and temporal lobe signs displayed moderate strength correlations with the numbers of different types of subjective psi experiences and the endorsement of exotic beliefs such as the possibility of previous lives and the conviction that ESP is real. Again both males and females shared these associations. Factor analyses (Table 7) verified the fact that childhood imaginings, temporal lobe signs, exotic beliefs and subjective psi experiences shared the same, strong source of variance for both sexes. Conservative (religious) beliefs, on the other hand, were either not related or negatively correlated with imaginings, exotic interests and temporal lobe signs. This pattern is similar to those found in other university populations where temporal lobe signs were positively related to exotic beliefs but not to the more conservative religious convictions [10, 15, 16].

That these associations were not an artifact of "yes" responding was indicated by the absence of significant correlations between these four categories and the control cluster for both males and females. Factor analyses verified that the cluster of control items loaded on a separate factor. It was not determined significantly by any of the four categories. These results answered our first question: imaginings and temporal lobe signs are derived from a single source of variance.

Separation of the temporal lobe scale into items that inferred "ictal-like" experiences and less intense correlates (the ILB scale) also revealed a type of "dose-dependency" whereby the TLS items that inferred more intense signs were most strongly correlated with the more extreme indicators of imagining. We [10, 12] had hypothesized that the experiences depicted by the complex partial epileptic (CPES) scale (TLS-primary, Table 4) were most related to the dissociation, depersonalization and capacity for vivid imagery that has been evoked by electrical stimulation during surgery [1-3, 6]. The significant moderate strength correlation between the CPES scale and the more extreme imaginings items contained within the Wilson-Barber inventory supported this hypothesis.

The significant positive correlations between exotic beliefs and the clusters of CPES items and extreme Wilson-Barber imagining items are expected associations according to Bear's concept of sensory-limbic hyperconnectionism [11]. It would predict that concepts (or word trains) that are unusual, strange or infrequent would be charged with emotional significance and personal value. Ideas that generate substantial imagery, such as time-travel, reincarnation and alien intelligence, would be particularly prone to this affective infusion from limbic sources.

Induction of such unique or intensified affective states, especially during childhood, would facilitate the development of more frequent or more extreme periods of dissociation in the adult. We have collected (unpublished) clinical evidence to suggest that the emergence of this pattern is found in the propensity for creative thinkers, including writers, poets, musicians, artists and scientists, to

have had developmental histories that could have promoted temporal lobe lability without overt seizure activity; clusters of such "promotors" include mild physical abuse, febrile episodes, minor head injuries and likely hypoxic periods during extreme physical exertion (competitive athletics).

Our second question concerning potential differences between males and females was clearly answered. Females reported significantly more early imaginings (moderate and extreme) and temporal lobe signs (primary and secondary) than males. They did not report significantly more psi experiences, religious beliefs or exotic beliefs compared to males (Table 2). Although females answered yes to more control items than males, this potential response bias was not responsible for the elevated temporal lobe signs and imaginings because they remained elevated even after covariance for the control scores.

Whereas the factor structures of males and females were similar when the total scales for temporal lobe signs, imaginings and exotic beliefs were considered, the factor structures differed (Tables 4 and 7) when the components of the scales were considered. For males, moderate and extreme imaginings were derived from the same source of variance as ictal-like temporal lobe experiences while for females the two categories of imaginings loaded on a single, separate factor.

This pattern is compatible with the observation that the females are more prone to imaginings [21] than males and hence only the more extreme imaginings are correlated with elevated TLS. However for males, who would be less prone to imagery, elevated TLS more closely simulates the neuro-cognitive characteristics of normal females; consequently for males, the two imaginings scales only loaded on the factor that contained ictal-like experiences. As support of this supposition, we have found that males who score higher on the CPES scale are significantly more prone to endorse the same non-temporal lobe items (e.g., they do not read mechanics magazines; they have kept diaries) as normal females. It may be relevant that males within verified limbic epileptic populations are more likely to display hypogonadism, hyper-prolactinemia [5, 7] and a shift towards feminine interests than males with less specific foci. The possible enhancement of normal feminine factors within the limbic-epileptic male brain would also support the concept of a continuum of temporal lobe lability [10, 12].

One chronic stereotype has been that males are more accurate than females when solutions to logical arguments are required; the supposition is very likely to be based upon anecdotal observation and the popular generalization of the differences between "intuitive" (female) vs logical (male) cognitive styles. The results of this study demonstrated that males and females *do not* differ with respect to the final accuracy in solving syllogisms. Howéver, the neurocognitive processes, as inferred from inventories of temporal lobe signs or childhood imaginings, by which the two sexes arrive at solutions may be quite different.

Males with greater numbers of temporal lobe signs were more accurate for invalid than valid items. Stated alternatively, males with the best accuracy for valid statements reported fewer temporal lobe signs. For females, temporal lobe

signs did not contribute to the validity-invalidity dimension. Instead, higher scores on the moderate dimension of imaginings facilitated the accuracy for valid more than invalid arguments. Despite the differential contribution from temporal lobe signs and imaginings for the two sexes, their absolute accuracy did not differ. These results support the suggestion that the two genders may utilize different strategies that lead to equal accuracies.

Our fourth question involved the degree to which temporal lobe signs, imaginings or beliefs determined logical accuracy. We had hypothesized that the affective dimension (upon which temporal lobe signs, imaginings, and beliefs are strongly represented) of the syntactic relationship within a logical argument could influence the inferencing process. As a result logical accuracy would be affected by the congruence between the person's beliefs and the concept that was encapsulated within the argument. A strong belief about, for example, exotic phenomena would affect the inferential process about ESP, alien intelligence or lunar influence, while less committed beliefs would have minimal influence. People with elevated temporal lobe signs would also be influenced by the affective dimension due to their tendency to infuse exotic, strange or infrequent concepts with meaning.

Our results supported this concept and elaborated the differences between gender. For both males and females, subjects who endorsed more exotic beliefs were more accurate for items that contained paranormal content rather than neutral content (Table 6). There were also sex differences. Males who displayed more frequent temporal lobe signs solved more items that contained paranormal content than items that contained neutral content. For females, those who had more frequent psi experiences accurately solved more items with paranormal content than with normal content. The unusually high ($r = 0.54$) correlation between exotic beliefs and accuracy, specifically for paranormal invalid terms compared to normal invalid terms, again supports the hypothesis that congruence between beliefs and the content of the logical argument can facilitate accuracy in its solution.

Whereas exotic beliefs were associated with temporal lobe signs, imaginings and relative accuracies in logical solutions as a function of subject content, our measure of conservative religious beliefs was either not correlated significantly or negatively correlated with any of these measures. These results support the conclusion of Clouse who reported that conservative Christians scored lower than liberal Christians on psychometric scales that measured higher levels of moral reasoning [23]. The possibility that conservative religious beliefs contribute to inflexibility of thinking was also indicated in our study for females only. Females who endorsed the most conservative religious beliefs were less accurate in their total accuracy for logical problem solving. Since there was no significant difference between males and females with respect to the numbers of religious beliefs, these results indicate that they affect the logical processes of females but not males and may explain Clouse's observation that females displayed less emphasis on higher modes of moral reasoning than did males [23].

If these weak relationships are generalizable, then the congruency between the problem solver's beliefs and the subject content of the problem may be important for its accurate solution. In the history of science belief in a putative effect or in the validity of a phenomenon is a frequent prerequisite to the objective discovery or solution. Traditionally these convictions have been considered sources of motivation and perseverance rather than a significant contribution to the inferential or logical process.

Our results suggest that liberal (exotic) belief but not conservative (religious) belief might affect the direction of the cognitive process at critical stages of bifurcation, thus either promoting or inhibiting novel extrapolations that could lead to discovery. This idea is commensurate with the concept developed by Hoffman [24]. For his model discourse-planning during cognition (which generally occurs outside of the conscious awareness of the individual) relies upon a "tree geometry." During discourse planning topical propositions occupy high nodal positions within the tree. It is here, at these nodes, where we are hypothesizing that exotic beliefs (controlled primarily by a history of temporal lobe signs [16]) affect the degree to which the propositional structure will follow a particular branch or depart from the tree structure totally. If the content or concept at the node is novel or infrequent, the temporal lobe lability would also affect the direction at the node by imbuing it with intense meaning and personal significance.

There is convergent support for the contribution of temporal lobe lability to the "switching" process at the nodes during problem solving. Hoffman indicated that manic patients display well-formed subtrees; however they were embedded in overall deviant structures that facilitated the rapid switching from one well-planned discourse structure to another [24]. Normal males and females who report more temporal lobe signs and childhood imaginings also display significantly elevated hypomania [10, 25] scores (T-scores between 65 and 70) on the Minnesota Multiphasic Personality Inventory (MMPI). Those who were most hypomanic were also those who were most prone to creative interests such as poetry; ease of dissociation, as defined by hypnotic induction profiles [13, 14] was conspicuous. Such rapid switching would be expected to promote problem solving when the hypomania and temporal lobe lability were within the mild to moderate range by increasing the number of different subtrees that were simultaneously addressed and compared during discourse planning.

REFERENCES

1. M. J. Horowitz and J. E. Adams, Hallucinations on Brain Stimulation: Evidence for Revision of the Penfield Hypothesis, in *Origins and Mechanisms of Hallucinations*, W. Keup (ed.), Plenum Press, New York, pp. 413-549, 1970.

2. J. R. Stevens, V. H. Mark, F. Erwin, P. Pacheco, and K. Suematsu, Deep Temporal Stimulation in Man, *Archives of Neurology, 21*, pp. 157-169, 1969.
3. G. F. Mahl, A. Rothenberg, J. M. Delgado, and H. Hamlin, Psychological Responses in the Human to Intracerebral Electrical Stimulation, *Psychosomatic Medicine, 26*, pp. 337-368, 1964.
4. D. M. Bear, Hemispheric Asymmetries in Emotional Function: A Reflection of Lateral Specialization in Cortical-Limbic Connections, *The Limbic System: Functional Organization and Clinical Disorders*, B. K. Doane and K. E. Livingston (eds.), Raven, New York, pp. 29-53, 1986.
5. D. M. Bear and P. Fedio, Quantitative Analyses of Interictal Behavioral Temporal Lobe Epilepsy, *Archives of Neurology, 24*, pp. 454-467, 1977.
6. H. G. Weiser, Depth Recorded Limbic Seizures and Psychopathology, *Neuroscience and Biobehavioral Reviews, 7*, pp. 427-440, 1983.
7. N. Geschwind, Interictal Behavioral Changes in Epilepsy, *Epilepsia, 24*, pp. 23-30, 1983.
8. D. M. Bear, L. Schenk and H. Benson, Increased Automatic Responses to Emotional Stimuli in Patients with Temporal Lobe Epilepsy, *American Journal of Psychiatry, 138*, pp. 843-845, 1981.
9. M. A. Persinger, Religious and Mystical Experiences as Artifacts of Temporal Lobe Function, *Perceptual and Motor Skills, 57*, pp. 1255-1262, 1983.
10. M. A. Persinger and K. Makarec, Temporal Lobe Epileptic Signs and Correlative Behaviors Displayed by Normal Populations, *The Journal of General Psychology, 114*, pp. 179-195, 1987.
11. D. M. Bear, Temporal Lobe Epilepsy: A Syndrome of Sensory-Limbic Hyperconnectionism, *Cortex, 15*, pp. 357-384, 1979.
12. K. Makarec and M. A. Persinger, Electroencephalographic Validation of a Temporal Lobe Signs Inventory in a Normal Population, *Journal of Research in Personality, 24*, pp. 323-337, 1990.
13. M. A. Persinger and C. F. DeSano, Temporal Lobe Signs: Positive Correlations with Imaginings and Hypnosis Induction Profiles, *Perceptual and Motor Skills, 58*, pp. 347-350, 1986.
14. J. Ross and M. A. Persinger, Positive Correlations between Temporal Lobe Signs and Hypnosis Induction Profiles: A Replication, *Perceptual and Motor Skills, 64*, pp. 309-311, 1987.
15. K. Makarec and M. A. Persinger, Temporal Lobe Signs: Electroencephalographic Validity and Enhanced Scores in Special Populations, *Perceptual and Motor Skills, 60*, pp. 831-842, 1987.
16. M. A. Persinger and K. Makarec, Exotic Beliefs May Be Substitutes for Religious Beliefs, *Perceptual and Motor Skills, 71*, pp. 16-18, 1990.
17. M. A. Persinger and P. M. Valliant, Temporal Lobe Signs and Reports of Subjective Experiences in a Normal Population: A Replication, *Perceptual and Motor Skills, 60*, pp. 903-909, 1985.
18. S. C. Wilson and T. X. Barber, The Fantasy-Prone Personality: Implications for Understanding Imagery, Hypnosis and Parapsychological Phenomena, *Imagery: Current Theory, Research and Application*, A. A. Sheikh (ed.), Wiley, New York, pp. 340-387, 1984.

19. K. Makarec and M. A. Persinger, Electroencephalographic Correlates of Temporal Lobe Signs and Imaginings, *Perceptual and Motor Skills, 64*, pp. 1124-1126, 1987.
20. J. A. Rotton, The Paralogic Test, Department of Psychology, Florida International University, North Miami, Florida, (unpublished, obtained from author)
21. E. L. Rossi, *The Psychobiology of Mind-Body Healing*, W. W. Norton, New York, 1986.
22. M. A. Persinger, Propensity to Report Paranormal Experiences Is Correlated with Temporal Lobe Signs, *Perceptual and Motor Skills, 59*, pp. 583-586, 1984.
23. B. Clouse, Moral Reasoning and Christian Faith, *Journal of Psychology and Theology, 13*, pp. 190-198, 1985.
24. R. E. Hoffman, Verbal Hallucinations and Language Production Processes in Schizophrenia, *Behavioral and Brain Sciences, 9*, pp. 503-516, 1986.
25. M. A. Persinger, MMPI Profiles of Normal People Who Display Frequent Temporal-Lobe Signs, *Perceptual and Motor Skills, 64*, pp. 1112-1114, 1987.

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